chose as his subject "The Relations between Light and Electricity." The lecture, afterwards published by Strauss, of Bonn, attracted great attention in Germany, and rapidly passed through half a dozen editions; it deserves to be better known in England. To students of science it will be a pleasure—not unmixed with sadness—to know that shortly before his untimely death he completed the manuscript of a new work on "The Principles of Mechanics." This book is already being prepared for publication, and those who have learned to value the insight and originality of the gifted author will eagerly watch for its appearance. D. E. J.

PROF. DR. RUDOLF WOLF.

IN Prof. Dr. Rudolf Wolf astronomical science loses one of her most devoted servants, and his death will be deplored not only by his countrymen and the observatory which he has directed since its foundation, but by astronomers all over the civilised world.

The services which he has rendered to astronomical science have not been restricted to one branch, although his name is generally spoken of with reference to sunspots.

Born on July 7, 1816, at Fällanden, near Zurich, he attended in his youth the higher schools in the last-mentioned city, where he made the acquaintance of the astronomer Horner, and began his first studies in mathematics and astronomy. He then went to the Vienna University in order to study astronomy under Littrow, and later to Berlin, at which place and time were Encke and Poggendorf. The year 1838 saw him in his home again, and this time his opportunities for astronomical studies were few and far between, as he had little time to spare, owing to his having accepted the post of a teacher in mathematics and physics at the town "Realschule" in Berne. In the year 1844 he commenced lecturing at the university, and in 1852 he obtained his Doctor's degree from the Berne Faculty, the same year becoming a member of that body itself by being appointed an Ausserordentliche Professor. About this time Wolf busied himself with a series of fine pieces of mathematical work, some of which were published singly, and others in various "Fachblättern," and in this year (1852) he published his "Taschenbuch der Mathematik, Physik, Geodäsie und Astronomie," a book which, owing to its clearness of exposition, passed quickly through a series of editions. One of the last pieces of work at which he was employed before he was overtaken by his illness was the sixth edition of this small book. The year 1847 was a very important one in the life of Prof. Rudolf Wolf, for it was at this period that he was appointed to the directorship of the small observatory of Berne. It was there that he began his well-known series of observations on sunspots, which he carried on without intermission to the end of his life, and which in connection with previous observations led to such important results. Owing to his memorable discovery of the relation between sunspots and earth magnetism his name first became better known, and it was more especially on this account that he received his promotion and a professorship of mathematics at the Berne University. In the year 1855 we find him returning as Professor of Astronomy to the newly-founded Swiss Polytechnikum, and at the same time to the university in his "Vaterstadt," where at a later date (1864) he received the appointment as director of the newly-built observatory in which he worked with great zeal to the end of his life.

The chief work which Prof. Wolf set himself to do was to obtain a continuous record of the spots on the solar surface; this led him later to examine older observations, and finally to compare their periods with those obtained from magnetic observations. As an astronomical observer Prof. Wolf was most diligent. Besides busying himself with observations of many different kinds, he made a point of regularly watching the sun's surface. For fifty years, it is said, he did not allow a single day, in which the sun was at all visible, to pass without observing its surface with one of the observatory instruments, or with a small pocket telescope he carried about with him for that purpose. The importance of Prof. Wolf's work will be gathered from the following brief historical sketch.

In 1851 Lamont, the Scotch director of the Munich Observatory, in reviewing the magnetic observations made at Göttingen and Munich from 1835-50, perceived that they gave indications of a period of $10\frac{1}{3}$ years. Sabine, in the following winter, ignorant of Lamont's conclusion, undertook a similar examination with very different data, and found that there was a maximum of violence and frequency about every 10 years; he it was, also, who first noted the coincidence between this result and Schwabe's sunspot period. The memoir containing this remarkable communication was presented to the Royal Society March 18, and read May 6, 1852; but on the 31st July following, Prof. Rudolf Wolf at Berne, and on the 18th August, Alfred Gautier at Sion, both announced similar conclusions, arrived at quite separately and independently. Prof. Wolf's work began then in real earnest, and he corrected Schwabe's decennial period to one a little larger than eleven (11·11), and pointed out the better agreement in the ebb and flow of magnetic change than Lamont's $10\frac{1}{3}$ year cycles. So minute and exact were his inquiries that by 1859 he found that very considerable fluctuations on either side of the mean period, which he had previously deduced, were noticeable; for might not two maxima rise to sixteen and a half years, or sink below seven and a half years? Prof. Wolf pointed out later (1861) that the shortest periods brought the most acute crises, and *vice versâ*; he it was, also, who suggested the idea of a longer sunspot period ($55\frac{1}{2}$ years).

Among other branches of astronomy to which Prof. Wolf turned his attention may be mentioned that of variable stars. It was in 1852 that he pointed out the striking resemblance between sunspot curves (representing frequency) and curves representing the changing luminous intensity of many variable stars. Auroræ, too, received Prof. Wolf's attention, and it was in the same year that, as he was examining Vogel's collection of Zürich chronicles for evidence to connect the weather with sunspots, he was led to associate luminous manifestations with solar disturbances. He also interested himself with regard to the announcement of the discovery of Vulcan, and collected all information of recorded appearances (?) of what were thought to be intra-Mercurian planets.

From his youth up, Prof. Wolf had a great liking for historical study, and was as familiar with the history of his science as he was with the special branch which he made his own. For several years he collected and brought together a great amount of "quellenmaterial," which was published in the form of his "Geschichte der Astronomie." Perhaps his "Handbuch der Astronomie" may be said to be his best work, for there his thorough knowledge of his science and his cleverness had complete scope. The matter in this book is treated with both scientific accuracy and literary ability, and is a wonderful instance of his still youthful capacity for work.

Towards the end of November last the first sign of illness showed itself, and during the first few days of December quickly developed, resulting in his death on December 6, at the age of 77.

Wholly devoted to the science which he loved, and a large contributor to astronomical knowledge, his name will be handed down to posterity. When the principles played with to-day are thoroughly perfected at some future date, and we can produce perfect pictures of all solar phenomena on a single plate, our future astronomers will

still look back on the work accomplished by Prof. Rudolf Wolf as a germ from which their work had developed, and as a monument of pains and industry. In his death, besides a true friend, we lose a thorough devotee to science, and we can ourselves mourn with his friends who say, "Und heute stehen seine Freunde aus allen Gauen des Vaterlandes trauernd am offenen Grabe, der Erde die sterbliche Hülle eines Mannes übergebend dessen geistige Grösse, persönliche Bescheidenheit und herzlichste, oft aufopfernde Liebenswürdigkeit allen die ihn gekannt haben unvergeszlich bleiben wird." W. J. L.

CLOUD PHOTOGRAPHY.

LA NATURE recently printed an article by M. A. Angot on the methods he has been employing in order to obtain the excellent photographs of clouds exhibited at the Paris Physical Society at the beginning of last year. The following is a free translation of the article:—

It is well known that ordinary photographic plates are most sensitive to blue and violet rays; hence the blue background of the sky acts, in general, nearly as much upon the plates as the white parts of clouds, which are thus rendered almost or entirely indistinguishable upon the photograph. It is possible, however, easily to obtain views of an interesting effect when, on a background of blue sky, large clouds pass before the sun. The edges of the clouds are then lit up to such an extent that they make much stronger impressions upon the sensitive plate than the sky itself; the remainder of the cloud is, on the contrary, dark, grey or black, and does not come out as well as the sky. To obtain an accurate picture under these conditions it is necessary to develop with great care: or better, to use a dilute pyro developer—a few drops of bromide of potassium solution and very little pyro to begin with; the development is then slowly carried on with the addition of carbonate of soda, and pyro is only added again towards the end if the plate lacks clearness.

This method ceases to give good results when it is applied to ordinary clouds, and becomes altogether useless for cirrus clouds. But these are precisely the clouds the study of which is most interesting; they are composed not of water vapour, but of ice-needles; and their forms and movements are closely connected with changes of weather. Cirri are the most difficult to photograph because, being farther from us than other kinds, they are less brilliant; and further, when they are seen, the sky is very frequently pale blue in colour, or covered with a milky veil, which diminishes the contrast.

Numerous plans have been proposed to photograph cirrus clouds. The first consists in photographing from the summits of high mountains, but that method is not within the reach of everybody. At such places the sky is, in general, much darker, and the clouds are better seen upon the background, so that excellent photographic images can be obtained without special devices. Another method has been proposed by Prof. Riggenbach, and appears to have some advantages. It consists in photographing the sky, using a diaphragm so small and giving an exposure so short that only a trace of the cloud-image appears after development. The plate is then intensified, and the image brought out by means of bichloride of mercury and sodium sulpho-antimoniate. This method, however, has little to commend it. In the first place, intensification is always inconvenient and destroys details, and further, the sodium salt very rapidly deteriorates, so there is always a risk of the plates being spoiled by becoming a very intense yellow colour, or being covered with a metallic deposit.

Prof. Riggenbach has suggested another and a better method, which is found to give excellent results. The method is based upon the fact that the blue light of the sky is partially polarised, whilst the light of clouds does not possess the same property. If, therefore, a convenient analyser (a Nicol's prism or black glass inclined at 55°) is placed in front of the lens of the camera, only a portion of skylight is obtained, while the light of the clouds remains unaltered, and the increased contrast renders it an easy matter to obtain a good picture. But at the same time, this method possesses inconveniences. The proportion of polarised light is far from being the same in all parts of the sky; hence it is not possible to photograph clouds in any direction. Moreover, many photographers object to the complications which are

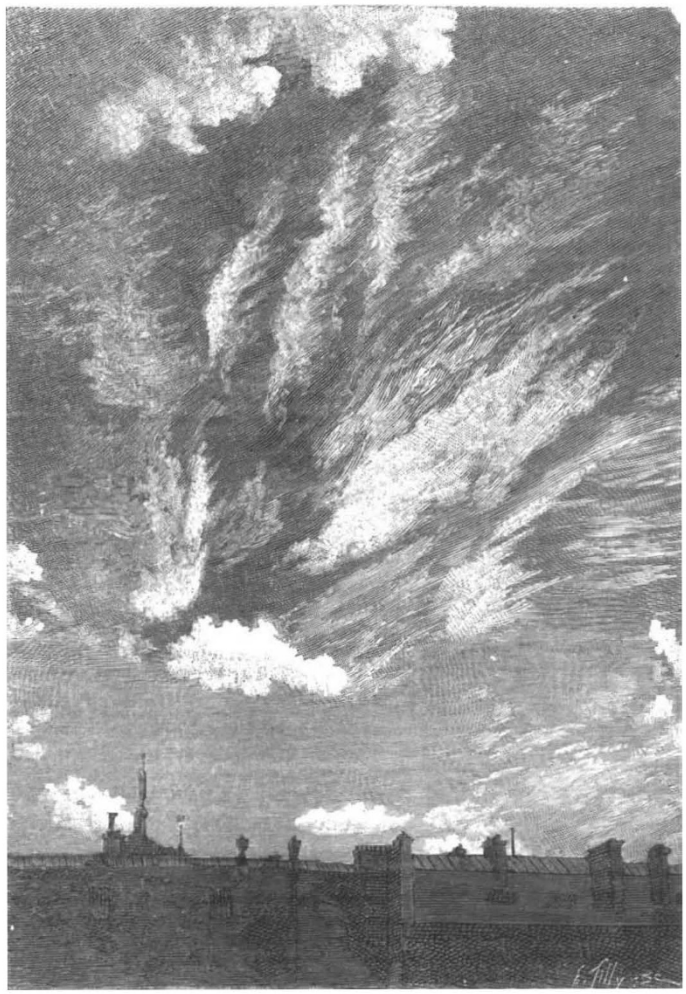

FIG. 1.—Cirrus Cloud preceding a Storm (March 31, 1892).